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REPORT ON IRRIGATION
IN THE
KISHANGARH STATE

WITH
NOTE BY THE CONSULTING ENGINEER FOR IRRIGATION
IN RAJPUTANA.

1903-04.

AJMER:
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REPORT ON IRRIGATION IN THE KISHANGARH STATE.

1. The Kishangarh State consists of a narrow strip of land 82 miles in length, extending from the southern banks of the Sambhar Lake on the north to the Khari River in the south. The breadth from E. to W. varies from 20 miles in the centre to from 7 to 10 miles at the ends.

Geographi-
cal
Features.

2. It has an area of 858 square miles, and is bounded on the north by Marwar, on the east by Jaipur and Ajmer, on the south by Shahpura and on the west by Ajmer and Marwar.

3. The north portion is crossed by parallel ranges of the Aravalli hills, Kishangarh, the capital, being situated in the southern of these ranges. The soil in this part is mostly sandy. The central portion is a plateau, with a fall from west to east with poor soil; and the south an undulating plain with good rich soil.

4. The level above the sea near the capital, where it reaches its highest point, is 1,532 feet. From here it gradually slopes away towards the north to 1,418 feet, and down to the south to 1,231 feet.

5. There are three main drainage areas in the State:—

Drainage
Areas.

(1) In the north portion the Rupnagar Stream (Drainage Area No. 1) which rises in Ajmer, and flows for about 24 miles from south-west to north-east through the centre of the Rupnagar District, and then falls into the Sambhar Lake, after draining an area of 184 square miles in Kishangarh.

(2) In the central portion (Kishangarh) the Mashi and its tributaries (Drainage Area No. 2), which rise in the hills near Kishangarh and flows in a south-easterly direction for 20 miles through the State, draining an area of 203 square miles, when they pass into Jaipur.

(3) In the southern portion (Sarwar) the Dain (Drainage Area No. 3), flowing from west to east for 12 miles across the State, draining with its tributaries an area of 160 square miles.

In addition to these, the various nullahs which eventually form the Shodra Nullah rise in the south-east of the central portion of the State.

6. The total area under cultivation in the whole State is 2,37,031 acres, of which 100,031 acres are Khalsa.

Area under
Cultivation.

7. The population of the State according to the Census of 1891 was 125,000, and according to the last Census only 91,000.

Population.

8. There are 231 villages in the State, of which 65 are Khalsa and 166 Jaghir.

Villages.

9. The average land revenue of the State is Rs. 2,05,000.

Land Reve-
nue.

Rainfall.

10. The average rainfall is 20 inches.

Means of
Irrigation.
Tanks and
Weirs.

11. There are 165 Irrigation tanks in the State and 1,000 small nadis for bed cultivation. 14 weirs have also been constructed across rivers at various points, with supply cuts to the tanks commanded. Of these 47 works have been constructed during the last 20 years. Practically all the old Irrigation works in the State up to the year 1865, were carried out by the advice of the late Thakur Gopal Singh and under his direction; and his son, the present Thakur Bharat Singh, has been responsible for most of those constructed during the last 35 years, and the State has been fortunate in possessing such natural Engineering talent.

12. In no State that I have visited has so much been done in the way of storage of water and protective works; dams and weirs have been constructed across almost every stream or nullah from place to place in its course; and the idea of not allowing a drop of water, which can be made use of to pass out of the State, has been, and is still, carefully carried out. All this is greatly due to the Diwan Sahib, Rai Bahadur Syam Sundar Lal, C.I.E.

13. The total catchment area thus secured for irrigation and protective purposes is about $\frac{2}{3}$ of the total area of the State, and is made up as follows:—

350 square miles for Irrigation Works.

200 square miles for nadis for bed cultivation.

Total ... 550 square miles.

Wells

14. The total number of wells in the State is 10,571, of which 1,580 belongs to Jaghirdars. About $\frac{2}{3}$ of the wells are in use, the remainder having fallen into disuse principally on account of the water failing in them during the last few years of successive deficiency of rainfall.

The average depth of water below the surface in the wells is 90 ft. in the north, to 65 in the central portion, and 50 ft. in the south; and the average cost of a "pucca" well is Rs. 800 and Rs. 300 for a kutchha well.

In the last 20 years several hundreds of wells have been made, and additional land brought under cultivation in consequence. Tacavi advances are given to those requiring it for the purpose, and a concession is also given, the State for the first few years realizing only $\frac{1}{3}$ of the total produce from the irrigation of the wells instead of $\frac{1}{2}$.

15. An average well can irrigate half a bigha in one day, and the average cost of watering 1 bigha comes to Rs. 2 for cotton and Re. 1 for other crops.

16. The area irrigated by wells is about 26,000 acres in normal years. In the famine year only 9,000 acres, or about $\frac{1}{3}$, was irrigated.

Field embankment.

17. In addition to tanks and wells, small field embankments are adopted to hold up surface water to assist bed cultivation, especially in the Rupnagar, Arain, and Kishangarh districts.

18. The total amount spent on Irrigation during the last 30 years amounts to Rs. 7,30,000 and the total yearly return on this outlay is Rs. 1,32,000. The average total area irrigated is Rs. 48,200 acres.

Average yearly expenditure on Irrigation.

19. There is a natural depression to the north-west of Karkeri (Site No. 1) on the Marwar border, which could be drained every year to make the bed available for irrigation, and this it is proposed to carry out.

Jheels.

20. Each drainage area will now be described in detail.

Drainage Areas described.
Rupnagar Stream

21. RUPNAGAR NULLAH (Drainage Area No. 1). The two branches which eventually join about 6 miles within the Kishangarh border and about 19 miles from their source, to form this stream, rise in hills to the north-east and south-east of Ajmer. On the north branch the tanks of Kair, Makarwali, Chadhiawas and Ararka have been constructed in its 12 miles course through the Ajmer district; and on the south branch, which flows for 16 miles through Ajmer, tanks have been constructed at Madarpura, Rasalpura, Ladpura and Mohami; and during the famine a new tank at Untra was commenced, but stopped later by the order of the Government of India on representations made by the Commissioner N. India Salt Revenue, that it interfered with the catchment of the Sambhar Lake.

22. In the Kishangarh State the following tanks exist on, or are supplied from the Rupnagar Stream :—

Existing Irrigation Tanks on Rupnagar Stream.

- (1) Kachil (Site A) an old tank built in 1859 about 2 miles within the Kishangarh border, and between the two branches of the stream, and about 2 miles above their junction. It is fed by a cut from the north branch of the river, across which a weir has been built.
- (2) The Fatch Sagar Tank (Site B) about 1½ miles south-east of Rupnagar on the Sirsiri Nullah built in 1890.
- (3) The Roop Sagar Tank (Site C) opposite the town of Rupnagar, lower down on the Sirsiri Nullah, built as a Famine Work in 1900.
- (4) The Rupnagar Tank (Site D) an old village tank, enlarged in 1900.
- (5) Weir across the Natati Nullah, with feeder to the Nawa Tank (Site E). This was constructed in 1902 with the approval of the Commissioner N. I. Salt Revenue (See para. 24 below).

23. The works proposed by the Kishangarh State in this drainage area, and which they are anxious to carry out, are :—

Works proposed

- (1) Storage Reservoir at Singla (Site No. 2), about 7 miles below the Kachil Tank, and 5 miles below the junction of the two branches of the Rupnagar Stream. Trial surveys have been made, and the following are the details of the project:—

Singla Project

The unintercepted catchment area is 47 square miles, all sandy, so that at most not more than 5 per cent. of the average rainfall of 20 inches can be calculated on as available for storage, or 110 m. c.ft.

For this the dam will be 14,400 r.ft. in length, consisting entirely of sand, with crest 22 feet above bed of nullah, top width varying from 15 to 20 feet in width, and front slope 4 to 1 and rear slope 3 to 1.

The weir would be 825 r.ft. in length at the east end near Thall village. Approximate estimated cost Rs. 58,500 or 1,880 c.ft. of water stored per rupee.

There is plenty of land below, so that when the tank fills it should be possible to irrigate 1,100 acres, or 3,300 bighas, allowing 100,000 c ft of water per acre, yielding a revenue of Rs. 6,600 at Rs. 2 per bigha, or over 11 per cent. profit.

In ordinary years on the sandy catchment, probably only half the water assumed above would be stored and half the revenue estimated realised : but this would be profitable, and the wells in the neighbourhood would also be benefited by the construction of the tank.

Manpura Project.

(2) *Manpura Project* (Site No. 3).—This is an excellent site for the construction of a Storage Reservoir on the branch of the Rupnagar Stream which rises near Parbatsar in Marwar. The dam would be built between two hills, through which the nullah passes. The basin is good, there is plenty of land below, and stone and kunkar for building are available at site. The site is close to the north-west border of the Kishangarh State : the catchment area is 22 sq. miles, a good portion of which is rocky, so that 10 per cent. of average rainfall should be available for storage or 105 m.c.ft. Trial surveys have been made, from which it is found that to store this the dam would be 36 feet above bed of nullah, and about 3,000 r.ft in length. It would have a face-wall of masonry built up to flood level ; or 3 ft. above weir level, backed with earth ; top width of earthen dam 12 ft. and rear slope 2 to 1. The weir would be at the south end 475 ft. in length to pass the maximum discharge with a 3 ft. head.

The approximate cost is estimated at Rs. 78,000, giving a rate of 1,343 c.ft. of water stored per rupee.

There should be sufficient water to irrigate 1,050 acres or 3,150 bighas, yielding a revenue, at Rs. 2 per bigha, of Rs. 7,300 : or a profit of nearly $9\frac{1}{2}$ per cent. on the estimated cost.

- (3) *Basra Project.* (Site No. 4).—The proposal is to re-build a very old bund which has been lying breached for years. The site is at the junction of the Sirsiri Nullah with the main stream, about $2\frac{1}{2}$ miles below Rupnagar. The un-intercepted catchment area is 25 sq. miles, but sandy, and not more than 58 m. c.ft. of water, or 5 per cent. of average rainfall, can at the most be assumed as available for storage. For this the weir level would have to be 17 ft. above the nullah bed, and the crest of the dam 6 ft. above this. The breaches it is proposed to fill in by a sand dam, top width 15 ft. where it crosses the nullah, front slope 5 to 1 pitched, and rear slope 3 to 1.

Basra
Project.

The weir should be at the north end 500 ft. long, and any overflow would pass down into the Parbatsar Nullah.

Two breaches, one 470 ft. and the other 1,000 ft. in length have to be filled in, and the dam will be continued on the north across the nullah for about 3,000 r.ft. The work is estimated to cost approximately Rs. 36,000, and if the full amount assumed of 58 m. c.ft. is stored, this gives a rate of 1,626 c.ft. per rupee.

Even if half the amount of water is stored there should be sufficient to irrigate 250 acres or 750 bighas, which should yield an annual revenue of Rs. 1,500, or over 4 per cent. on the estimated cost, and any water stored in this part of the district would be of great value to the State, as the water level in the wells is very low.

- (4) At Sanodia (Site No. 5) near the Sambhar Lake, something could be done in the way of flooding the land by a cut from the Rupnagar Stream, the water being held up until the soil was saturated, when crops could be grown.

Sanodia
Project.

24. But none of these projects can at present be undertaken under the orders of the Government of India. In April 1902 the Commissioner, N. I. Salt Revenue, wrote to the Government of India describing the various sources of supply of the Sambhar Lake, and stating how certain tanks in the Rupnagar valley catchments interfered with that supply, and thought that in addition to affirming generally the principle that the lake-supply must not be further intercepted or impeded, the Government should take some action to free the Rupnagar Stream from some of its existing obstructions.

Objection
raised to
construc-
tion of
works in
Rupnagar
valley by
Commis-
sioner, N. I.
Salt Reve-
nue.

The Government of India in reply (letter No. 3779—Finance and Commerce, dated 13th July 1901) directed that—

- (a) A continuous record of observations should be taken, which will indicate more fully the extent to which the supply of water to the lake is being affected by the obstacles referred to by the Commissioner, N. I. Salt Revenue.

- (b) That it was most inadvisable, considering the precariousness of the supply in the lake, that any new reservoirs should be constructed in the catchment area.
- (c) That the Commissioner, N.I. Salt Revenue, should be consulted before any existing works were enlarged, strengthened, or improved.

25. Observations of the rainfall and river discharges in the Rupunagar valley are, in consequence, being taken each year by the Executive Engineer, Ajmer Provincial Division, and from these definite conclusions may be arrived at, from which it may be possible for Kishangarh to reasonably ask that the question may be re-considered once more, and that the works mentioned above may be taken in hand.

Mashi River.

26. **MASHI RIVER.** (Drainage Area No. 2).—The Mashi and its tributaries rise in the branch of the Arravallis near Kishangarh city, and in the detached hills on the east of the central portion of the State, and flow in a south-east direction for 20 miles across the State, when they pass into Jaipur.

They drain an area of 203 sq. miles. The whole of this drainage area is fully utilised; so much so, that Jaipur has complained that the Kishangarh State has more than its fair share of water, and that existing irrigation works in their own State, supplied from the Mashi, are interfered with, and has asked for some assurance that no further works will be undertaken in this catchment, either new works, or enlargements and extensions of existing works.

The case is now under arbitration.

Irrigation works on Mashi River

27. Including the Goondaloo and Ram Samand Lakes at the Kishangarh city itself there are 11 Irrigation Storage Reservoirs and 5 Weirs with supply cuts on this drainage area, as per list given below:—

- | | | |
|---------------|-----|--|
| AT KISHANGARH | ... | (1) Goondaloo (Site F). |
| | | (2) Ram Samand (Site G). |
| AT DINWARA | ... | (3) Madan Sagar (Site H). |
| | | (4) Jai Sagar (Site I), with feeder to same starting from |
| | | (5) Weir at Jarkhera (Site K). |
| AT KATSURA | ... | (6) Ganesh Sagar (Site L). |
| | | (7) Bhawani Sagar (Site M) with feeder to same starting from |
| | | (8) Weir at Chosla (Site N). |
| AT ABEEN | ... | (9) Koria Tank (Site O) with feeder to same starting from |
| | | (10) Weir on Rai Nullah (Site P). |
| AT GOGUNDA | ... | (11) Goguunda Tank (Site Q) with feeder starting from |
| | | (12) Gogunda Weir (Site R) across Mashi. |
| AT SIRONDA | ... | (13) Jawahir Sagar (Site S.) with feeder from |
| | | (14) Weir across Dang Nullah (Site T). |
| | | (15) Sukh Sagar (Site U.) with feeder from the Jawahir Sagar (No. 13) and Gogunda Weir (No. 12.) |
| | | (16) Taj Sagar (Site V). |

There are also a great number of nadis in this catchment; and on the northern branch, which flows for about nine miles through the State by Banda Sendri, draining an area of 26 sq. miles, three Irrigation Storage Tanks have also been constructed. This branch joins the Mashī at Kheri in the Jaipur State.

28. The proposals for new works on this drainage area consist of:—

Proposed
works on
Mashī
River.

- (1). A supply cut to the Jawahir Sagar (Site S.) from a weir to be constructed across the Mashī about 3 miles above the Gogunda Weir (Site R).
- (2). A supply cut from the river near Kandach to supply a tank at Tehri (Site 6) which will be extended and enlarged for the purpose.
- (3). The construction of low weirs across the river at intervals to increase percolation to wells.

Whether these can be constructed or not will depend on the settlement of the case at issue as to the distribution of the water of the Mashī between the Kishangarh and Jaipur States.

29. Supply cuts have been excavated to catch and divert water which flows away to the north-west of the range of hills north of Kishangarh into the Goondalao and Ram Samand Lakes, and there is now a proposal to connect these two to form one lake.

At present the overflow from the Goondalao, the large lake on which the Palace stands, passes into the Ram Samand, the dam and weir of which are at a lower level. The proposal, as pointed out to me at the site, consists in continuing the Goondalao Dam across to a ridge on the north-east and above the present dam of the Ram Samand. No extra water would be stored by this arrangement, and the only thing gained from the expenditure would be a single and large sheet of water which would be visible from the Palace instead of 2 tanks, one of which is not in view. The proposed alteration is not an Irrigation work, and it is for the Durbar to decide whether they consider it will be of sufficient benefit to the Palace and City to warrant the expenditure.

30. **DAIN RIVER** (Drainage Area No. 3).—The two branch streams which form the Dain River rise in the Aravallis south-west of Nasirabad, and flow in a south-easterly direction till after a course of about 18 miles, they unite at Kesarpura village Dain River.

On the north branch in the Ajmer district the Jagpura and Chat Tanks have been constructed, also a weir with feeder to the Hanwantia Tank; and on the south branch there is the large Niaran Tank, and lower down the Thakur of Kalania has a weir with feeder to supply a very large tank at Motipura on the left bank, and the Thakur of Tantuti a weir with feeder to supply three tanks at Bhagwanpura, on the right bank.

Below Kesarpura the river continues its course for 9 miles through the Ajmer district, when it enters Kishangarh, passing for 15 miles from west to east across the southern portion of the State, and being joined on the left bank by the Fatchgarh Nullah, and on the right at the east

border by the Arnia Nullah. With these two tributaries it drains an area of 135 sq. miles in Kishangarh. The Dain then re-enters the Ajmer district (Kekri Circle), for another 13 miles, from whence it passes into Jaipur, and eventually joins the left bank of the Banas River at Bicalpur near Rajmahal.

Existing
Irrigation
Works on
the Dain
Weir and
feeder to
Sarwar
Tanks.

31. On the east border where it enters Kishangarh territory (Site No. W). a weir was built across the river some 28 years ago, and a supply cut excavated which feeds five tanks belonging to the town of Sarwar.

Hintoli
Weir.

32. Nine miles lower down, just above the junction with the Fatehgarh Nullah another weir was built in 1890 (Site No. X.), with a feeder to one of the Hintoli Tanks, but this breached the following year and has never been repaired, as it was thought that the percolation to wells below would be interfered with. Personally I do not think this would be the case, as only a small quantity of the flood water would be stopped and diverted, and I would recommend this weir being re-built, and to proper section and the cut repaired.

33. The Diwan now suggests building a dam across the river itself, from Manpura on the left bank to some high ground on the right, about 1 mile below Hintoli, the object being to irrigate land on the left bank of the river; but as this would submerge a quantity of well land on the right bank, and would interfere with the existing tanks at Hintoli, it is not recommended.

If anything is done here it would be better to re-construct the weir at Hintoli, continuing it across the Fatehgarh Nullah too, and take a canal away on the left bank to some point where a Storage Reservoir would be constructed to command and irrigate land on that side of the river. Trial surveys for this will be made.

34. A low weir has also been built across the river above Hingonia, which holds up water for the benefit of the wells above, and this system might be carried out at other points below with the same object, but nothing more can be done on the main stream.

Feeder to
Fatehgarh
Tank.

35. On the Fatehgarh Nullah, which rises in the hills north-east of Nasirabad, and flows for 28 miles through Ajmer district before entering Kishangarh, several large tanks, notably Ramisar and Barol, have been constructed in Ajmer, and at the Kishangarh border a cut has been made from the right bank to divert water into the very fine tank at Fatehgarh. This cut is about 3 miles long, and is only about 5 ft. wide, but the last mile is all in deep rock cutting, so that it is an expensive work and has cost about Rs. 20,000.

Dhanma
Project.

36. About 2 miles within the State there is a good site on this nullah for a Storage Reservoir at Dhanma (Site No. 7) which is being surveyed.

The unintercepted catchment area at the site is 16 sq. miles, and the dam will be 9,800 r. ft. in length, and will start on the left bank at Dhanma village itself, which is on a high mound, and, crossing the nullah at a good rock crossing, will be extended up to the feeder channel to Fatehgarh Tank on the right.

The weir will be about 20 ft. above the bed of the nullah, and will be on the left bank and across the nullah itself, and part of the overflow will also pass down the feeder, so that a portion of the excess water may find its way to the Fatehgarh Tank.

The tank will submerge some 15 doris and 10 wells on the bank of the river between Barogla village and Dhanma, but these have little water in them, and only irrigate on an average about 4 bighas each, or 100 bighas of cultivated land will be submerged. This need not be considered, as the land in the bed, about 1 sq. mile, is all good, and will be benefited, and will all be cultivated as the water recedes; on the other hand the land below on the left bank fit for cultivation is limited, and on the right, below Fatehgarh, is already irrigated by wells, but these should be benefited by the construction of the tank, and up to Fatehgarh for about a mile in length there is good land lying idle requiring irrigation.

37. On the south tributary (Arnia Nullah) which rises in the Ajmer district at Kinai, about 5 miles west of the Kishangarh border, and after flowing for 12 miles in a north-east direction, joins the Dain on the east border of the State, the following Irrigation works have been constructed:—

Tanks at
Chakwa
and Maia

(a) At Chakwa two tanks were constructed many years ago (Site No. Y).

(b) And, close by at Maia (Bhagwantpura) a large dam was constructed about 15 years ago, but this is useful for bed cultivation only, as there is little land below.

(c) At Arnia, a new tank has been constructed, which was commenced in 1901, and is still incomplete (Site No. 8). This was one of the Projects entered in the Report submitted to the Irrigation Commission and recommended for execution. The catchment area at site is 15 sq. miles. The dam is 8,300 r.ft in length, with crest 23 ft. above nullah bed, and 5 ft. above weir, which is 600 ft. in length; and the tank has a capacity of 73 m. c.ft.

Arnia Tank

The dam is of earth, with a core-wall for 1,000 r.ft. in centre, viz., 500 ft. on either side the main nullah; the front slope is 3 to 1 pitched, and rear slope 2 to 1.

The soil, except at the ends, is unsuitable for an earthen dam, as it consists of a mixture of gravel and light soil, and the core-wall should have been continued all along this bad portion.

During the last rains, after an exceptional heavy fall of 3" of rain, the dam breached, the water getting through at the south end of the core-wall.

The breach has since been temporarily closed and about 6 ft. of water above sluice stored, but a core-wall or face wall will now have to be constructed for the whole length where this bad earth occurs, or the tank will never be safe.

There is plenty of good land below, now a grass "bhir," and I suggested that the State Overseer, who is in charge of the work, should take surveys for extending the dam to see if the weir could be raised 2 ft., to be built at the north end across the Chakwa Nullah.

The tank would then be able to take up all the overflow from the Chakwa and Bhagwantpura Tanks; and with a greater capacity a greater area below could be irrigated.

Rs. 50,000 have been spent so far on the work, and it will probably cost Rs. 20,000 more, but when it is properly completed and Irrigation Ducts constructed it should pay quite $6\frac{1}{2}$ per cent., as there will be sufficient water to irrigate 2,200 bighas, all of which is available, and from which an annual revenue of Rs. 4,400 should be derived; and this irrespective of bed cultivation.

(See Appendix II—Note on Arnia Tank by the Consulting Engineer for Irrigation).

Ajgira Weir
and Feeder.

(d) Five miles below Arnia, and just below where the nullah crosses the Deoli Road, at Ajgira (Site No 7) a weir was constructed during the Famine, and a cut made to supply the Lilai Tanks, at a cost of Rs. 8,000.

The weir is 113 ft. long with top 8 ft. above the nullah bed and 2 ft. above the weir level of the Lilai Tanks; it is built on soft rock, which is found 6 ft. below the bed.

The cut has a fall of 1 ft. per mile. The water last rains cut round the weir on the right bank, leaving a gap of 90 ft. between the weir and bank, and the first year it cut round on the left bank.

The site for the weir is not a good one, but was selected as the highest point available *below* the Deoli Road, and the Kishangarh Durbar wished to open work quickly in the famine time, and any alterations to the Deoli Road, necessitated by a site for head works above, would have led to correspondence and delay.

The weir was inspected by the Consulting Engineer, and if it is repaired, as suggested by him, it must be continued for about 50 ft. into the right bank to prevent any chance of the water cutting round again; and dry stone, 10 ft. in width, and 2 ft. in depth should be laid right across the bed in continuation of the existing apron on the down stream side, with blocks of heavy stone, or concrete, at the outer edge to prevent movement, and to avoid a hole being formed in the bed by the overflow water, near the foundations.

To obtain a greater quantity of water down the cut, the weir might be raised 2 ft., but in this case it would have to be reconstructed throughout to proper section.

At present the weir is only 4 feet thick.

It would perhaps be better if arrangements could be made with Government to make use of the masonry road dam in the 31st mile of the Deoli Road as the weir for the Lilai feeder. This is 2 ft. higher than the Ajgira Weir, but would have to be raised a little, and sluices provided to the openings under the dam, which would be kept open directly a sufficient supply had passed down the cut. The cut would start above the road and would pass under it, a culvert being constructed.

All this could easily be carried out, and would do no damage to the road, and would benefit Kishangarh, who are quite willing to pay for carrying out the necessary alterations to the road dam, and for the culvert under the road if it can be arranged.

About $\frac{1}{4}$ mile above and west of the Deoli Road the earthen embankment for the Kekri-Nasirabad Railway was constructed during the famine, and it is doubtful whether this line will ever be carried out, at any rate not for some years to come.

If Kishangarh could obtain sanction to make use of this earth-work and be allowed to fill in the short portion across the Ajgira Nullah, which has been left unfinished, a Storage Reservoir could be formed at very little expense, and the water from this could be utilized in irrigation below, and passed down the feeder channel to supply the Lilai Tanks as required. This would be the best plan of all, if it could be arranged.

(See Appendix I —Note on Ajgira Weir and Feeder by the Consulting Engineer for Irrigation.)

(e) Three miles below Ajgira at Shapunda (Site No. 9) an old weir was constructed many years ago; the site is an excellent one, good rock all the way across the nullah, the bed of which is rocky for some distance below. The weir in its present form is of very little value, but a low dam for storing the water which overflows from Arnia and Ajgira, might be easily constructed at this site to irrigate the land below.

Dam at
Shapunda

38. There are only two other works in this southern portion of the State which should be carried out.

(a) The construction of a dam across the nullah by Kacholia (Site No. 10). This would not be a large work, and the State can easily carry this out without help or surveys from us. There is good land below the site available and requiring irrigation.

Proposed
Tank at
Kacholia.

Sopan
Tank.

- (b) The completion of the dam commenced at Sopan (Site No. 11). This is an earthen dam nearly 2 miles in length, which was commenced in the famine; the bank is at present only about 3 ft. in height, and it is proposed to make the weir 7 ft. above nullah bed, and to build a face wall, and complete the earthwork and construct sluices.

There is plenty of good land both in the bed and below, black soil on which wheat can be grown; and the work should be completed, but the weir should not be made higher than that now proposed, as the Thakur of Pranhera in the Ajmer district, commenced a dam in the famine on the same nullah, and his claim to a share of the waters must be considered.

Small
Projects
on catch-
ments
of exist-
ing works
in Jaipur
and
Ajmer.

39. In the central portion there are a few nullahs which rise in the State and run for a few miles in a south-east direction before entering Jaipur, and proposals for small Storage Reservoirs were shown me by the Diwan at Dotli, Pandarwara, Gujarwara and Dhos, but none are worth taking up, and in any case could not be carried out, as they are on tributaries of the Shodra Nullah, and would cut off water from the Lamba Tank and the large Tori Sagar which have been constructed in the Jaipur State. In the same way on the Tikaora Nullah, which flows in a south-west direction on the west border into Ajmer, existing works in that district prevent any interference to their catchment areas.

The Kish-
angarh
State well
protected
with
irrigation
works

40. This report, however, shows that the Kishangarh State has done a great deal, in fact nearly all that there is to be done, in the way of storage and protective works; and is fully alive to the value of making use of all the water which passes through the State to its own advantage and improvement.

In the north of the State (Rupnagar Stream) if the observations now being taken show that the restrictions at present laid down preventing new works in the Rupnagar valley, can be removed, the Kishangarh State will at once carry out the Projects noted in para. 23 above.

In the central portion (Mashi River) all has been done already.

In the south (Dain River) the few works remaining are in course of construction, or being surveyed.

F. ST.-G. MANNERS-SMITH,
*Superintending Engineer, Protective
Irrigation Works, Rajputana.*

February 1904.

NOTE BY THE CONSULTING ENGINEER
FOR
IRRIGATION IN RAJPUTANA.

NOTE BY THE CONSULTING ENGINEER FOR IRRIGATION IN RAJPUTANA.

The "Note on Irrigation in the Kishangarh State" by Mr. Manners-Smith, submitted herewith, shows how much can be done, even in a small State, in the way of Irrigation.

Although the length is only 82 miles and the width varies from 20 to 7 miles, giving a total area of 858 sq. miles, yet there are no less than 165 Irrigation tanks, 1,000 small *nadis* for bed cultivation, 14 weirs across rivers with supply cuts to tanks commanded, 10,571 wells, and several small field embankments to hold up surface water.

Although the average land Revenue is said to be only Rs. 2,05,000, yet in the last 30 years the amount spent on Irrigation is stated to be Rs. 7,30,000 ; an average annually of about $\frac{1}{8}$ th of the Revenue of the State.

The total yearly return on this outlay is said to be about Rs. 1,32,000 ; if this is correct it represents a return of about 16 per cent., which is encouraging.

Considering the small area and the small revenue, there is no State where so much has been done. Dams or weirs have been made across almost every nullah, in one place or another, and the idea of not allowing any water to pass out of the State to waste has been steadily carried out ; so that the total area of catchment secured is about $\frac{2}{3}$ rd of the total area of the State.

All this is most creditable to the State and to all concerned, and shows how much can be done by natives, even when entirely unassisted by Europeans, when a real interest is taken in the work ; in fact so much has been done that it has caused remonstrance from the Imperial Government on the north, and from the Jaipur State on the east.

This is perhaps a healthy sign, showing that the value of water is being appreciated.

The only two places the Consulting Engineer was asked to see were the broken weir at Ajgira and the earthen bund at Arnia ; his remarks on each are attached.

The Note submitted by Mr. Manners-Smith, Superintending Engineer, shows that he has, with his usual energy and interest in the subject, gone thoroughly into the investigation of Irrigation Projects in the Kishangarh State, and he deserves credit for the way in which he has done it.

S. S. JACOB, COLONEL.

Consulting Engineer for Irrigation.

March 1904.

APPENDIX I.

On the 28th February 1904, the Consulting Engineer, with the Superintending Engineer (Mr. Manners-Smith), and the Overseer of the Kishangarh State (Babu Parse Das), inspected the masonry weir at Ajgira, and the cut made from it to supply water to tanks below.

The weir is 130 ft. long and 8 ft. high and is built of very inferior masonry; there is a masonry flooring about 10 ft. wide on the down stream side. The soil is sandy. The weir was previously breached at the north end, but was repaired. Last rains it was breached at the south end, where a gap of about 60 ft. now exists, showing how it has been outflanked.

The Superintending Engineer has given the history and particulars regarding this work, it is unnecessary therefore to say more here.

The points brought forward for consideration are—

- (1) Whether the unfinished Railway bank above the Deoli-Nasirabad Road shall be taken advantage of.
- (2) Whether the Masonry Road Dam on the 31st mile of the Deoli-Nasirabad Road shall be adopted as the weir.
- (3) Whether the present broken weir shall be repaired.

Regarding (1) if the Railway is not to be completed, it seems a pity some use cannot be made of the bank which has been thrown up; not only here, but in many others places. If it is permitted to fill in the portion across the Ajgira Nullah, which has been left unfinished, a storage tank no doubt could be made here, and the water from it could be used in irrigation, and some of it could no doubt be passed down the feeder channel to supply the Lalai Tanks, with the advantage of the increased head. The uncertainty, however, that exists about the completion of the Railway, and the delay and correspondence which would occur, makes it advisable to adopt some other place.

Regarding (2) the Masonry Road Dam in the 31st mile of the Deoli-Nasirabad Road. The road dam would form a good weir to divert the water of the nullah, and at a small expense an increased head of water could be obtained.

The disadvantages are—

- (1) That the cut would have to be taken off at least three feet lower than the top of the road dam, unless it is raised.
- (2) It would be necessary to make a culvert, or another road dam, to get the water across from the west to the east side of the road.
- (3) As the ground is higher here, this would necessitate some cutting and expense.

- (4) If the cut is then taken on the north side of the existing village tank, as proposed by the Overseer, it would cut off the surface drainage to the tank. Some arrangement if the levels permit, would be necessary to prevent this, or the tank would be rendered useless.

If the cut is taken on the south side of this tank; it would be necessary to avoid the broken ground in this direction and to go quite close along the bank of the tank, to avoid cultivated land.

- (5) The permission of Government would have to be obtained to make use of, or add to, the masonry road dam, and this would cause also delay and correspondence.

Regarding (3) to repair the broken weir; this—

- (1) Would probably cost less than any other proposal.
- (2) The amount which has been already spent on it would not then be thrown away.
- (3) No correspondence or delay need arise in carrying out the work.

For the above reasons it seems better to repair the broken weir.

If it is decided to do this, it will be necessary to adopt the following precautions :—

- (a) To take the ends of the weir well into each bank, so as to prevent the water getting round either flank.
- (b) To have a quantity of large rubble stone or concrete blocks laid along the whole length of the toe, beyond the present masonry flooring, about 10 ft. wide and 2 ft. deep—the outer edge to be made of *large* blocks—the whole to be let into the ground, not merely placed on the surface.
- (c) If the foundations of the existing work do not rest on rock or hard ground, then it will be advisable to put a bank of earth against the weir on the upstream side sloping 3 to 1, covered with large stone or kunkar blocks, to prevent any scouring action along the inside, or the water may work its way underneath.

If the weir is to be raised 2 feet, it will have to be considerably strengthened.

If the Durbar have any doubt as to what course to adopt, it will be advisable to have levels taken and a plan and estimate prepared for each proposal. When these are ready the Durbar will no doubt be able to decide, or if still in doubt, to refer to the Superintending Engineer.

APPENDIX II.

On the 28th February 1904, with the Superintending Engineer (Mr. Manners-Smith) and the Overseer of the Kishangarh State, the Consulting Engineer inspected the bund at Arnia.

The work was begun during the recent famine, A.D. 1901. The bund is about 8,300 ft. long, the crest is 23 ft. above the nullah bed and the top 5 ft. above weir level. The catchment is 15 sq. miles of hard ground. The capacity is 75 m. c. ft. About Rs. 50,000 have, it is said, already been spent on the work. The quality of water stored per rupee at this rate will be about 1,500 c.ft. only, which is not favourable; but the work was undertaken as a relief work, and the Kishangarh Durbar deserve credit for undertaking such a good work. There is any amount of good land commanded, and if the work is properly completed, it will undoubtedly be of great benefit.

A masonry core-wall was made for a length of 1,000 ft., viz., 500 ft. on each side of the main nullah, but this is not sufficient. The soil is not suitable for an earthen bund excepting at the ends. In the last rains a breach occurred at the south end of the core-wall. The gap was temporarily repaired with earth, and about 6 ft. of water was stored.

The inner slope is much cut up, wherever it has not been covered with kunkar.

It is suggested that the following work should be now carried out :—

- (1) To extend the masonry wall. Either as a core-wall or as a face wall (whichever will cost less) until the good earth is reached; care being taken that it is put well into the solid ground, especially where the breach occurred, so that there shall be no fear of the water getting round the ends of the wall, or underneath it.
- (2) To adopt the natural high ground on the north end as the level of the weir or H. W. L. so that any surplus water shall pass off over it, directly into the Bhagwantpura Nullah.

If the water escapes round the north end of the bund at a lower level, as it now would do, there is a danger of it cutting up the irrigation ducts on its way to lower end.

- (3) To keep the top of the bund, not less than 6 ft. above the level of the weir.

An estimate should be prepared, as soon as possible for the above.

It is important that the work should all be completed before the next rains, or there may again be damage; the bund is not considered safe as it now is.

It may be advisable hereafter to raise the bund 2 ft. as suggested by the Superintending Engineer, if experience shows that all the water that comes is not stored, so as to catch any overflow from the two tanks above at Chakwa and Bhagwantpura, and to include the nullah also at the north end, where a suitable escape could easily be made. This would increase the capacity of the tank considerably. It is a work that can be carried out at any time.